CHE323/CHE384
Chemical Processes for Micro- and Nanofabrication
www.lithoguru.com/scientist/CHE323

Lecture 36
Etch, part 3

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Reading:
Chapter 11, *Fabrication Engineering at the Micro- and Nanoscale*, 4th edition, Campbell

Etch Tradeoff

	High Selectivity	Low Selectivity
High Anisotropy	?	Sputter Etching
Low Anisotropy	Plasma Etching or Wet Etching	

Plasma Etching Steps

1. Electron strikes a gas molecule, creating free radical
2. Free radical diffuses to wafer surface
3. Free radical is adsorbed onto surface
4. Reaction at surface
5. Reaction product is volatilized, diffuses into gas

Generally this process is isotropic, with potentially high selectivity

Reactive Ion Etching (RIE)

- A kind of ion-enhanced plasma etching
- Use ion bombardment to significantly increase the rate of one of these steps
  - Surface adsorption
  - Surface reaction
  - Byproduct removal
- Chemical etching occurs only where the ions strike, giving both selectivity and anisotropy

RIE Possible Mechanisms

- Ions may break bonds on surface, making the surface more reactive
- Etch reaction products may stay on surface until sputtered off by ions
- Etch byproducts (polymers from etched resist, for example) may coat the surface until sputtered off by ions
  - Called sidewall passivation or polymerization

Sidewall Passivation

Fabrication Engineering at the Micro- and Nanoscale, 4th edition, Campbell, p. 310

Figure 11.11 Schematic diagram of a high pressure anisotropic etch showing the formation of sidewall passivating films.

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Reactive Ion Etching (RIE)

- RIE can produce good selectivity, high anisotropy, and moderate etch rates
- Sometimes
- Every RIE process is custom – unique to the film being etched, the mask material, and the etch stop layer
  - Control is sometimes difficult

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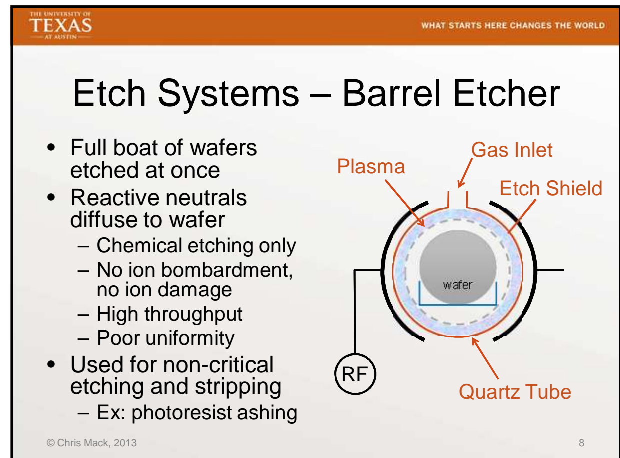

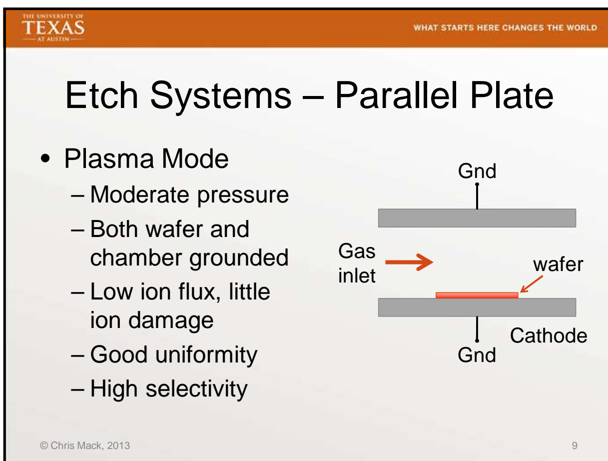

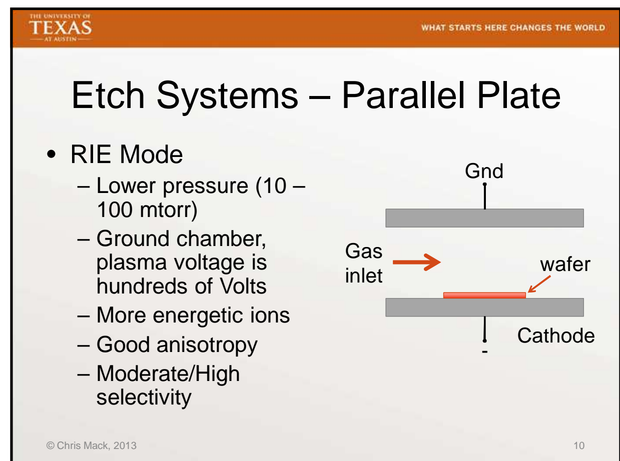

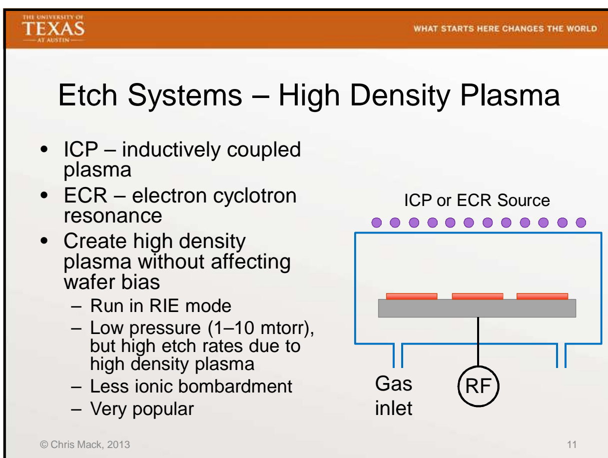

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Lecture 36: What have we learned?

- What problem is reactive ion etching trying to solve?
- How does RIE work?
- What is sidewall passivation?
- What are the characteristics of barrel etchers and why are they used?
- Why are high density plasma systems popular?

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